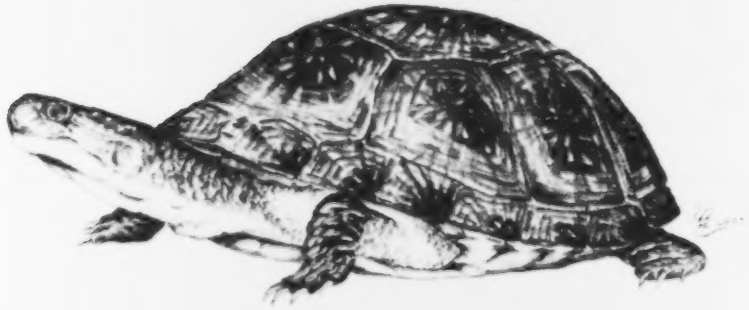
COSEWIC
Assessment and Update Status Report

on the

Blanding's Turtle
Emydoidea blandingii

in Canada

Nova Scotia population
Great Lakes/St. Lawrence population



NOVA SCOTIA POPULATION - ENDANGERED
GREAT LAKES/ST. LAWRENCE POPULATION - THREATENED
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

2007-00451

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COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
Blanding's Turtle (Nova Scotia population)

Scientific name
Emydoidea blandingii

Status
Endangered

Reason for designation
The three small subpopulations of this species found in central southwest Nova Scotia total fewer than 250 mature individuals. These three subpopulations are genetically distinct from each other and from other Blanding's Turtles in Quebec, Ontario and the United States. Although the largest subpopulation occurs in a protected area, its numbers are still declining. The other subpopulations are also susceptible to increasing habitat degradation, mortality of adults and predation on eggs and hatchlings.

Occurrence
Nova Scotia

Status history
Designated Threatened in April 1993. Status re-examined and designated Endangered in May 2005. Last assessment based on an update status report.

Assessment Summary – May 2005

Common name
Blanding's Turtle (Great Lakes/St. Lawrence population)

Scientific name
Emydoidea blandingii

Status
Threatened

Reason for designation
The Great Lakes/St. Lawrence population of this species although widespread and fairly numerous is declining. Subpopulations are increasingly fragmented by the extensive road network that criss-crosses all of this turtle's habitat. Having delayed age at maturity, low reproductive output and extreme longevity makes this turtle highly vulnerable to increased rates of mortality of adults. Nesting females are especially susceptible to roadkill because they often attempt to nest on gravel roads or on shoulders of paved roads. Loss of mature females in such a long-lived species greatly reduces recruitment and long-term viability of subpopulations. Another threat is degradation of habitat from development and alteration of wetlands. The pet trade is another serious ongoing threat because nesting females are most vulnerable to collection.

Occurrence
Ontario, Quebec

Status history
Designated Threatened in May 2005. Last assessment based on an update status report.

COSEWIC
Executive Summary

Blanding's Turtle
Emydoidea blandingii

Species information

The Blanding's Turtle, *Emydoidea blandingii*, is a medium-sized freshwater turtle largely confined to the Great Lakes Basin. In addition to lakes, it inhabits both permanent and temporary ponds, streams, and wetlands. Blanding's Turtle is the only representative of the genus *Emydoidea* in the family Emydidae. The upper shell (carapace) is domed and smooth and may be up to 27.4 cm in length. The carapace is characterized by a grayish-black colour with tan to yellow spots or flecks scattered at random. The markings tend to get smaller and may fade altogether as the turtle ages. The lower shell (plastron) is a rich yellow and each scute (section) has a black blotch in the outer posterior corner. The plastron is hinged so that some individuals can completely close their shell. Males have a concave plastron, to facilitate copulation, whereas the female's plastron is flat. Adults of both sexes have a bright yellow lower jaw and throat, and this is the species' most characteristic feature.

Distribution

In its Canadian range, the Great Lakes/St. Lawrence population of the Blanding's Turtle is located throughout southern and south-central Ontario as far northwest as the Chippewa River in Algoma West, continuing eastward across the province into extreme south-western Québec. However, the Ontario distribution is not continuous and there are gaps in the Bruce Peninsula and surrounding areas to the south and southwest. As well, this species does not occur in the extreme southeast portion of the province and some areas north of Lake Ontario. The population in Québec appears to be concentrated around Gatineau Park and adjacent areas, close to the southwest boundary of the province along the north shore of the Ottawa River.

A small disjunct population occurs in Nova Scotia at the northeast periphery of the species' range. The Nova Scotia population is the most isolated population in the species' entire range. Blanding's Turtle's known range in Nova Scotia is limited to two watersheds in the central southwest portion of the province. At least three distinct sub-populations are recognized within the Nova Scotia population complex. One occurs in a protected area, Kejimkujik National Park, and the other two are in working landscapes outside of the park. These subpopulations are genetically distinguishable, with limited gene flow among them (~1.8 - 5.8 migrants per generation).

In the United States, the Blanding's Turtle's range occurs in the northern states, from Nebraska eastward to Ohio and Michigan and south to Missouri. There are also small local populations in New York, Massachusetts, New Hampshire, and Maine. The U.S. populations are often separated by natural barriers including large bodies of water such as the Great Lakes, and by artificial barriers including residential areas, commercial development, and major highways.

Habitat

In Nova Scotia, the Blanding's Turtle tends to prefer darkly coloured water indicative of relatively higher secondary productivity. However, this is not necessarily true in the Great Lakes/St. Lawrence population, where Blanding's Turtles are often observed using clear water, eutrophic habitats. An individual turtle may use several connected lakes, rivers, streams, marshes, or ponds and travel upwards of 6760m in an active season. Turtles of all ages occur primarily in shallow water, with adults and juveniles showing slightly different habitat preferences. Adults are generally found in open or partially vegetated sites, whereas juveniles are more reclusive by nature and prefer areas that contain thick aquatic vegetation including sphagnum, water lilies and algae. The Blanding's Turtle nests in a variety of loose substrates including sand, organic soil, gravel and cobblestone. Overwintering occurs in permanent pools that average about one metre in depth, or in slow flowing streams. Hatchling turtles may be able to withstand temporary freezing, as they have been noted to spend the night terrestrially upon emerging from their nests in late October and early September, and may possibly be terrestrial during their first winter.

Biology

Female Blanding's Turtles mature between 14 and 25 years of age. Upon reaching maturity, adult females produce a maximum of one clutch per year of 3 to 19 eggs, but often less frequently, until 75+ years of age. Adult and juvenile Blanding's Turtles have a narrow thermal tolerance, and perhaps because of this, bask regularly. The embryos also have a narrow thermal tolerance; eggs incubated below 22°C or above 32°C will not develop properly. The Blanding's Turtle exhibits temperature sex determination, and eggs incubated at or below 28°C will produce males, while eggs incubated above 29°C will produce females. Eggs are laid in June, with hatchlings emerging in late September and early October. The cool Canadian climate results in a short active season, which limits nest success. Temperatures often fall below the minimum required for normal development or before full development can be completed. The Blanding's Turtle is an exceptionally long-lived and late-maturing species, even for a turtle. Maturation in Canadian populations may be as late as 25 years, and turtles can survive in the wild in excess of 75 years. These life-history traits combined with a small reproductive output and concomitant low recruitment makes this species vulnerable to even tiny increases (<5%) in annual mortality of adults.

Population sizes and trends

The size of the Great Lakes/St. Lawrence population of Blanding's Turtle is impossible to estimate accurately. Rough estimates suggest there could be about 10,000 individuals. However, this is an extremely crude guess. The population size in Québec has not been estimated, but evidence suggests that it is extremely small. These turtles live at low densities, perhaps at densities of less than one adult per km^2, and populations are often isolated from one another. Monitoring of trends in habitat loss, and of population trends from other regions, indicates that the Great Lakes/St. Lawrence populations are probably declining because of ongoing loss and fragmentation of habitat.

In Nova Scotia, the well-studied population in Kejimkujik National Park shows very late maturity (20-25 years), great longevity (over 70 years), small clutch size (mean=11 eggs), and poor nest success (less than 50%). This population has declined due to habitat alteration, collection, road mortality, and other anthropogenic causes. A recent population viability analysis identified an alarming decline in the Kejimkujik National Park population. This analysis, based on survivorship and reproductive data from the population, has suggested that management actions are necessary to reverse the decline. Currently, it is estimated that there are only 210-245 adults in Nova Scotia.

Models based on demographic data from a long-term study on Blanding's Turtle populations in Michigan indicate that population stability of such a long-lived, late-maturing species requires an annual juvenile (ages 2-14 years) survivorship of at least 76%, and an annual adult survivorship of at least 96%. It is likely that Canadian populations require even higher annual survivorship to maintain numbers because they experience even later maturity than the Michigan turtles.

Limiting factors and threats

Nest predation by raccoons, skunks, foxes and coyotes is the most significant cause of nest failure. There are few predators of mature turtles as their carapace strength and overall size deters or prevents most predation attempts. Cool summer temperatures may also increase the rate of nest failure, and result in the production of less viable hatchlings. A recently discovered source of nest failure is depredation by sarcophagid fly larvae. Additionally, in Nova Scotia, many nests are laid on lakeshore cobblestone beaches and are susceptible to flooding during wet years.

Development of wetlands and their surrounding areas significantly reduces the amount of available and suitable adult and juvenile habitat, and destroys potential and existing nesting habitat. Females are attracted to the gravel shoulders of roadways for suitable nesting habitat. This increases the risk of mortality to nesting females, as well as emerging hatchlings, as they are often struck and killed by vehicles.

The pronounced yellow chin and throat of the Blanding's Turtle contribute to its overall beauty. Unfortunately, being one of the more colourful and personable species of

turtles has made it sought after in the pet trade. Captive bred yearling Blanding's Turtles are advertised in the United States for a relatively high price for a single specimen making the potential financial windfall very appealing to those who are willing to catch and sell turtles illegally. Most often adults are taken from the wild because they are easier to locate and catch, as well as being worth more in the pet trade. Removal of individuals from the reproducing population is a severe risk to the survival of long-lived species, as fluctuations in adult survivorship have a great impact on population stability.

Special significance of the species

The Blanding's Turtle is the only representative of the genus *Emydoidea*. It has one of the smallest global ranges of any North American turtle. A large portion of its global range (20%) is contained within southern and south-central Ontario and the extreme southwest edge of Québec. With Ontario and Quebec containing such a large portion of the global range of this species, these provinces have a significant responsibility towards the conservation of this species.

The Nova Scotia population has been the object of intensive study since 1987, and has provided important data on demography and life history of this long-lived species. The isolated Nova Scotia Blanding's Turtle populations have diverged genetically from populations in the main range, and contain a high degree of genetic variation and distinctness, and are therefore likely an important evolutionary component of the species.

The Blanding's Turtle has been a "poster" species for conservation in Nova Scotia, Québec, Michigan, Wisconsin, Minnesota, and other jurisdictions. The species has also been important in theoretical studies; for example as the subject of the longest running study of turtle populations (at the E.S George Reserve in Michigan), where it has been used to test hypotheses of aging and hence is of great interest in gerontology.

Existing protection

The population of Blanding's Turtles in Nova Scotia was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1993 as Threatened, and was designated Endangered by Nova Scotia in 2000. The Ontario population has been listed as Threatened in 2004, on the recommendation of the Committee on the Status of Species at Risk in Ontario (COSSARO). Habitat protection is afforded under the Ontario Provincial Policy statement of the planning act, and this species is also featured in Ontario's forest management planning process. In Québec, Blanding's Turtle has been ranked S1 by NatureServe Québec, and the Quebec Provincial Advisory Committee recommended a status of Threatened in 2003, with listing expected in 2006.

Blanding's Turtle is listed by NatureServe as being at risk in 15 of 16 states that it inhabits in the United States. It is Extirpated (SX) from Rhode Island, Critically Imperiled (S1) in 3 states, Imperiled (S2) in 6 states, Vulnerable (S3) in 5 states, and Secure (S4) only in Nebraska.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.
** Formerly described as "Not In Any Category", or "No Designation Required."
*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Blanding's Turtle
Emydoidea blandingii

in Canada

Nova Scotia population
Great Lakes/St. Lawrence population

2005

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SPECIES INFORMATION

Name and classification

Blanding's Turtle (*Emydoidea blandingii*) was originally named and described by Holbrook (1836) as a member of the genus *Cistuda*. The classification was based on morphological characteristics resembling the European Pond Turtle, *Emys orbicularis* (then *Cistuda europea*), and the Eastern Box Turtle, *Terrapene carolina* (then *Cistuda carolina*). Blanding's Turtle was then grouped in the genus *Emys* with *E. orbicularis* based on morphological similarities such as unkeeled carapaces, kinetic shells, and colouration (Feldman and Parham 2002). It remained as such until separated into the genus *Emydoidea* as the sole member (McCoy 1973). *Emydoidea* was considered to be closely related to the Chicken Turtle of the genus *Deirochelys* by McDowell (1964). However, based on electrophoretic myoglobin polymorphism, the family Emydidae was separated into the subfamilies Emydinae and Deirochelyinae (Seidel and Adkins 1989; Feldman and Parham 2002).

It has been recently recommended that the genus *Emydoidea* be reclassified within *Emys*. Feldman and Parham (2002) suggested that the Blanding's Turtle be placed in *Emys* based on morphological and ecological traits as described by Loveridge and Williams (1957). The traits described include feeding mechanisms that involve cervical elongations and highly modified skulls.

Morphological description

Adults

Relative to other freshwater turtles, Blanding's Turtles are of medium size with a moderately high, domed carapace that lacks keels or sculpturing. Colouration of the carapace is generally black or dark brown, with some individuals exhibiting lighter shades of gray or brown. The carapace is often marked with yellowish or tan streaks and spots; however, these markings are highly irregular and variable among individuals. The plastron exhibits a semi-functional hinge between the pectoral and abdominal scutes. Individuals show variation in the flexibility of the hinge, with some turtles being able to close the plastron entirely, whereas others have almost no flexibility. Each scute on the plastron is yellowish with a single dark spot, occurring on the outer edge of each scute. A 'V' shaped notch is present at the rear of the plastron between the anal scutes, and growth annuli are usually well defined on the plastral scutes.

The plastron of the male Blanding's Turtle is moderately concave and the vent of the male turtle extends beyond the edge of the carapace. Female Blanding's Turtles have a flatter carapace and a narrower tail, with the vent anterior to the edge of the carapace.

Total carapace length ranges between 15.2cm and 27.4cm. The chin, throat, and underside of the neck are this species' most characteristic feature, generally being

bright yellow, or occasionally creamy, in colour. The sides of the neck and top of the head are variable in colour, generally dark brown or black in males, but lighter in colour and even mottled in females (Ernst *et al.* 1994). The beak is notched on the upper jaw (Ditmars 1907; Harding 1997; Conant and Collins 1998), and the mouth curves upward in a devilish smile. The neck is quite long.

Hatchlings

Hatchling Blanding's Turtles have a carapace length of 2.5 to 4 cm and differ in colour from adults. Hatchlings have a grey, brown, or black carapace devoid of patterning. The plastron is characterized by a central black spot surrounded by yellow or cream colouration. The transverse hinge on the plastron is non-functional in hatchlings and young juveniles, and the tail extends well beyond the rear of the carapace. The head may have lightly coloured spotting and the characteristic yellow throat and chin are present. Colours are generally brighter in younger individuals than in adults (Harding 1997; Conant and Collins 1998). The tan/yellow spots and streaks on the carapace develop in juveniles after the second year, and these markings are most noticeable in 3- to 6-year-old turtles.

Genetic description

Recent and ongoing genetic assessment in the Nova Scotia population, as well as across the species' range, has improved our understanding of population genetic structure. Surprisingly, the small and isolated Nova Scotia population contains a high degree of genetic variation; sometimes this variation is greater than in populations within the species' main range (tested samples include Massachusetts, Wisconsin, Minnesota, Illinois, Michigan and Ontario) (Mockford *et al.* 1999; Ruben *et al.* 2001). The Nova Scotia population has also diverged significantly from the tested populations in the main range (Mockford *et al.* 1999; Ruben *et al.* 2001; Mockford unpublished data). Even within the Nova Scotia population complex, the three known sub-populations are genetically distinguishable despite being separated by only short geographic distances (as little as 15 km) (Mockford *et al.* 2005). Genetic analysis suggests limited, although significant, gene flow between these subpopulations (1.8 - 5.8 turtles per generation). Even within subpopulations, genetic structure is evident (McEachern 2003; Toews 2005; as cited by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005). (Nova Scotia information provided by Tom Herman and Jennifer McNeil, pers comm. Jan. 24, 2005).

Designatable units

The Canadian population of Blanding's Turtles can be divided into two geographically separated units. The first unit is the Nova Scotia population, which received designation from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1993 as Threatened (Herman *et al.* 1995). This population represents the extreme northeastern area of the species' range, and is separated from the rest of the species' range by several hundred kilometres (Figure 1).

Figure 1. North American range map for the Blanding's Turtle (*Emydoidea blandingii*)

The second Canadian designatable unit, referred to in this report as the Great Lakes / St. Lawrence population, exists within Ontario and Québec, with approximately 20% of its global range being contained within these two provinces (Austen and Oldham 2001). The Québec population could possibly be considered a third unit, separated from the Ontario population (Daniel St-Hilaire, pers. comm. 2005). Damming of the Ottawa River may have led to the isolation of the Québec population from that of Ontario. This perception warrants further investigation, but currently there is not sufficient evidence to support this hypothesis.

DISTRIBUTION

Global range

Approximately 20% of the Blanding's Turtle's global range is contained within Canada, particularly Ontario, as the species' range is centred in and around the Great Lakes Basin. In the United States, the species' range extends from Nebraska eastward through Iowa, South Dakota, Minnesota, Missouri, Wisconsin, Illinois, Indiana, Michigan, Ohio, and Pennsylvania (Ernst *et al.* 1994; Power *et al.* 1994; Conant and Collins 1998) (Figure 1). There are also small local populations in New York, Massachusetts, New Hampshire, and Maine in addition to isolated populations in the previous states (Power *et al.* 1994; Ruben *et al.* 2001; Brodman *et al.* 2002). Across its North American range, the Blanding's Turtle often occurs as isolated populations that are geographically separated by natural barriers such as large lakes, fast-flowing rivers, and mountain ranges. More recently and often, the separation is a result of anthropogenic barriers such as roadways, and commercial and residential developments (Joyal *et al.* 2001).

Canadian range

In Canada, the Blanding's Turtle is found across southern and south-central Ontario, in the extreme southwestern edge of Québec (Bider and Matte 1994; Austen and Oldham 2001; St-Hilaire 2003; Ontario Herpetofaunal Summary 2004; Québec Atlas of Amphibians and Reptiles data bank 2005), and in two watersheds in Nova Scotia (Herman *et al.* 2003).

In Ontario (Figure 2), the Blanding's Turtle is located throughout southern and south-central Ontario as far north as the Chippewa River in Algoma West (Bob Knudsen, pers. comm. Feb. 22, 2005) and continuing eastward through Algoma East and Elliot Lake (Jim Trottier, pers. comm. Feb. 21, 2005) to Ottawa (Ontario Herpetofaunal Summary 2004). According to the Ontario Herpetofaunal Summary (OHS) (2004), sightings since 1990 have occurred in the counties and districts of Algoma, Brant, Elgin, Essex, Frontenac, Haldimand-Norfolk, Haliburton, Halton, Hamilton-Wentworth, Hastings, Huron, Kawartha Lakes, Kent, Lennox and Addington, Lambton, Lanark, Manitoulin, Middlesex, Muskoka, Nipissing, Northumberland, Ottawa-Carleton, Parry Sound, Peel, Peterborough, Prince Edward, Renfrew, Simcoe, Sudbury, Waterloo, Pelee Island and York. Since 1990, there have been no reported sightings of

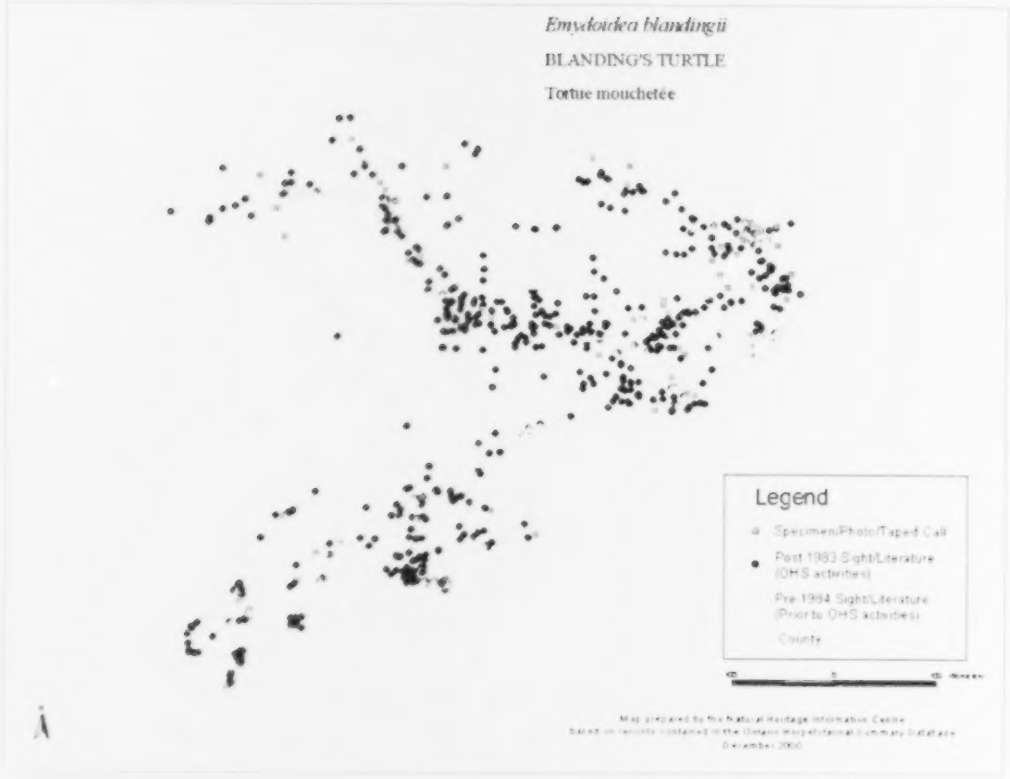

Figure 2. Ontario herpetofaunal Summary Atlas. Blanding's Turtle (*Emydoidea blandingii*) (2005).

the Blanding's Turtle in Durham, Niagara, and Oxford, and the species may be extirpated from these districts. There are no recorded sightings in the Bruce Peninsula, or in the districts of Bruce, Grey, Huron, Perth, Dufferin and Wellington. This lack of sightings is perplexing as there are still some wetlands and suitable habitat present in these areas (Michael Oldham, pers. comm. Oct. 13, 2004). Another gap in the range of the Blanding's Turtle occurs in extreme southeastern Ontario in the districts of Prescott, Russell, Stormont and Dundas, and Glengarry. In these areas, there are only a few suitable wetlands remaining and this may explain the lack of sightings (Michael Oldham, pers. comm. Oct. 13, 2004).

In Quebec (Figure 3), the range is limited to the southwestern edge of the province and appears to be continuous with the Ontario population (Bider and Matte 1994, St-Hilaire 2003; Herman *et al.*1995; Québec Atlas of Amphibians and Reptiles data bank 2005). According to the Québec Atlas of Amphibian and Reptiles data bank (QAAR), sightings have occurred in the counties of Pontiac and Portneuf, and tend to centre on the towns of Bristol and Bristol-des-mines. The Québec population appears to

Figure 3. Québec Range map for the Blanding's Turtle (*Emydoidea blandingii*). (Centre de données sur le patrimoine naturel du Québec. 2005).

be centred in a region close to the border with Ontario, near Ottawa, although there have been other isolated sightings; one close to Montreal, and another northeast of Rouyn-Noranda (St-Hilaire 2003). It is not clear whether these isolated sightings represent two remnant populations, or if they are turtles that have been released from captivity (Centre de données sur le patrimoine naturel du Québec 2005).

In Nova Scotia (Figure 4), the known populations are located on two watersheds in the southwestern portion of the province, although anecdotal sightings have been reported from adjacent watersheds (Herman *et al.* 2003). At least three distinct sub-populations are recognized within the Nova Scotia population complex; one occurs in a federally protected area (Kejimkujik National Park), and the other two in working landscapes outside of the park's boundaries. The Nova Scotia populations are the most isolated, and are disjunct from the rest of the species' range. They are considered to be relict from a warmer period when the turtle had a more continuous distribution along the eastern seaboard into Nova Scotia (Herman *et al.* 1995). Currently in Nova Scotia, the range of the Blanding's Turtle is restricted to the inland plateau where summer temperatures are higher than in the rest of the province (Power *et al.* 1994). (Nova Scotia information supplied by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005).

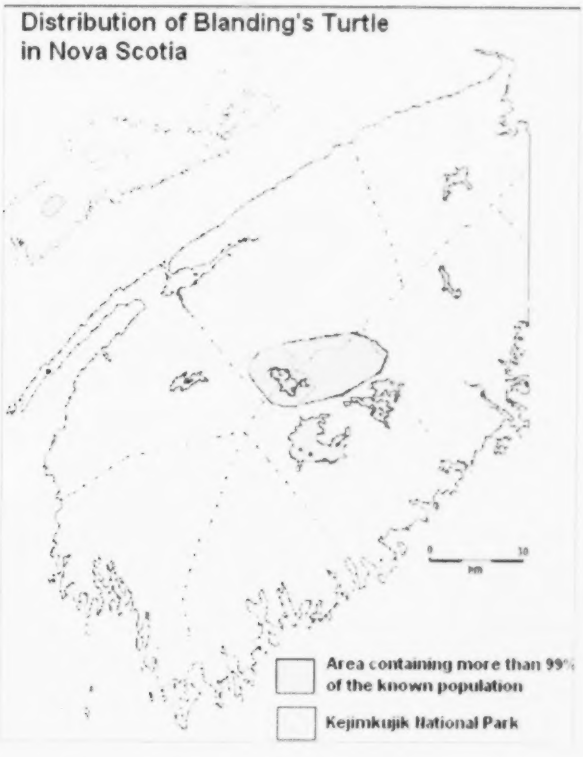

Figure 4. Nova Scotia range map for the Blanding's Turtle (*Emydoidea blandingii*). (Blanding's Turtle Recovery Team 2004).

HABITAT

Habitat requirements

The Blanding's Turtle is a largely aquatic turtle that occurs in a variety of wetland habitats including lakes, permanent ponds, temporary ponds, slow flowing brooks, creeks, marshes, river sloughs, marshy meadows, man-made channels, farm fields, coastal areas and the bays of Lake Erie (Kofron and Schreiber 1985; Petokas 1986; Rowe 1987; Ross and Anderson 1990; Rowe and Moll 1991; Pappas and Brecke 1992; Ernst *et al.* 1994; Power *et al.* 1994; Herman *et al.* 1995; Joyal *et al.* 2001; Gillingwater and Brooks 2001, 2002). In general, the preferred wetlands occupied by the Blanding's Turtle are eutrophic, and are characterized by shallow water with an organic substrate and high density of aquatic vegetation (Ernst *et al.* 1994; Herman *et al.* 1995). Occasionally, individuals can be found inhabiting upland wooded areas.

Blanding's Turtles will travel seasonally over land between aquatic areas (Ruben *et al.* 2001) to locate suitable basking and nesting sites (Joyal *et al.* 2001; Bury and Germano 2002; Semlitsch and Brody 2003). Despite these seasonal movements, Blanding's Turtles have strong site fidelity (Piepgras and Lang 2000). In Nova Scotia, they are often associated with peaty soils and coloured water as these areas tend to have higher secondary productivity than do clear waters in this region (Power *et al.* 1994). Beaver activity is present at most Blanding's Turtle sites in Nova Scotia, and is believed to play an important role in water level control (Herman *et al.* 2003).

Suitable basking sites must be present where the turtle can remove itself from the water and gain access to direct sunlight. These basking sites can be partially submerged logs, rocks, bog mats, or suitable shoreline. Blanding's Turtles may also bask in open areas while travelling over land through upland wooded areas (Joyal *et al.* 2001). Juveniles bask on sphagnum mats (McMaster and Herman 2000), emergent sedges, in alder swale, and in shallow water surrounding emergent root masses (Pappas and Brecke 1992). The vegetation around water bodies favoured by Blanding's Turtles can vary to a great degree, but usually consists of plants that thrive in highly eutrophic conditions.

Adult turtles overwinter in permanent bodies of water (Joyal *et al.* 2001) and, in some cases, seasonally isolated wet depressions or ponds (Power 1989). Turtles will densely aggregate in overwintering sites in Québec (St-Hilaire 2003) and in Nova Scotia, with up to 14 individuals at a single site (Herman *et al.* 2003). In Nova Scotia, individuals tend to return to the same sites each year (Herman et al 2003). During the winter months, the Blanding's Turtles do move, although only in limited amounts (a few metres) (Ernst *et al.* 1994). Over the majority of the range very little is known about the overwintering requirements of the Blanding's Turtle.

Terrestrial habitat is also important, as these turtles will travel overland more than 2.5 km to nest (Jennifer McNeil, Tom Herman, pers. comm. Jan 24, 2005), and will nest up to 410m from the nearest water source (Joyal *et al.* 2001). Terrestrial habitat is generally upland wooded areas, consisting of mixed deciduous or coniferous forest.

Adults

Adult Blanding's Turtles require both aquatic and terrestrial habitats. In southern Maine, they prefer permanent ponds and lakes (Joyal *et al.* 2001), and in Nebraska, adult turtles spend over 50% of their time in these habitats (Bury and Germano 2002). It is thought that these permanent bodies of water offer an abundance of food. Less cover and refugia are required for adults since they are less susceptible to predation than juveniles. Adult Blanding's Turtles will use multiple bodies of water throughout the active season, travelling upwards of 6760m during an active season in southern Maine (Joyal *et al.* 2001), presumably to locate food or a mate. During spring, adult females travel up to 1620m in Maine (Joyal *et al.* 2001), and up to 7000m in Nova Scotia (Jennifer McNeil, pers. comm. Jan 24, 2005) to nest. In Nova Scotia, Blanding's Turtles primarily occupy beaver-regulated wetlands associated with small streams or adjacent lakeshores (Herman *et al.* 2003). On Pelee Island, adults utilize the canal system and inland wetlands more often, and are not often observed making use of coastal Lake Erie habitats (Ben Porchuk pers. comm. April 1, 2005). In Québec, one female travelled 1700m between her nesting site and summer habitat, and another travelled almost 2000m to reach hibernacula (St-Hilaire 2003).

Juveniles

Juveniles spend the majority of their time in marsh habitat in Nebraska (Bury and Germano 2002), southern Maine (Joyal *et al.* 2001), and Minnesota (Pappas and Brecke 1992). This habitat presumably offers increased opportunities for refuge, decreasing the potential of predation. Juveniles are more susceptible to predation due to their small size, and thus require a greater availability of refugia to increase their chances of survival. Pappas and Brecke (1992) in Weaver Dunes of Wabasha County Minnesota, suggest that Blanding's Turtles with a carapace length less than 100mm prefer habitat that has an abundance of cover and stay close to the water's edge where vegetation offers considerably more refuge than does open water. Turtles with a carapace length greater than 100mm inhabited open water microhabitats more often.

Juvenile Blanding's Turtles in Nova Scotia are found in similar areas as adults, but again occupy different microhabitats and show seasonal differences in distribution (McMaster and Herman 2000). Juveniles are most often associated with floating sphagnum mats and abundant shrub cover. McMaster and Herman (2000) found that young juveniles (age 1-7 years) were more often visible than older juveniles (age 11-13), which seems to contradict the hypothesis that younger turtles seek more cover to avoid predation.

Hatchlings

Hatchlings emerge from their nests in late September and early October (Standing *et al.* 1999; Herman *et al.* 2003). Nests are usually laid in loose sand and organic soil throughout most of the species' range. However, in Nova Scotia, females primarily nest on cobble lakeshore beaches and rocky outcrops of freeze-fractured material, and

secondarily use roadside gravel. Some turtles must travel more than 200m from nest to water in Nova Scotia (Standing *et al.* 1999), and more than 400m in southern Maine (Joyal *et al.* 2001). This large distance from nest to water may be why some hatchlings will overnight terrestrially. As a result of spending nights on land, hatchling Blanding's Turtles may be susceptible to increased mortality rates from mammalian and avian predators.

Once hatchlings reach a body of water, they occupy fringe habitat never straying far from cover provided by aquatic vegetation, partially submerged floating logs, or terrestrial vegetation that has grown over the water surface. Characteristically, the most obvious feature of suitable juvenile habitat is dense *Sphagnum* moss growth with overlying vegetation (McMaster and Herman 2000). The fact that hatchlings are frequently found hiding under floating organic cover (Pappas and Brecke 1992) may contribute to the low occurrence of reported sightings. However, a more accepted and probable explanation for the low occurrence of sightings is a high nest failure rate (Congdon *et al.* 1983) and a low annual survivorship, among hatchlings and juveniles because they are more susceptible to predation (Pappas and Brecke 1992).

Overwintering sites for hatchlings remain unknown. In Nova Scotia, studies of hatchling movement patterns shortly after nest emergence indicate that most hatchlings do not immediately seek water, raising the possibility that they may overwinter terrestrially (Standing *et al.* 1997; McNeil *et al.* 2000). In a recent laboratory study of cold hardiness and dehydration resistance of hatchling Blanding's Turtles from Nebraska, Dinkelacker *et al.* (2004) concluded that terrestrial overwintering may be possible if the habitat remains moist enough to prevent dehydration. Although there have been no reports of hatchlings hibernating on land, it does appear to be a possibility, but it is probably not commonplace.

Habitat trends

Wetland habitat in southern Ontario and Québec has undergone continued drainage and development since the early 1800s. This continued destruction threatens the sustainability of the Great Lakes/St. Lawrence Blanding's Turtle populations. Development results in increased traffic on existing roadways, as well as the creation of new roadways. Road-killed turtles have been reported all across south-central Ontario (Bob Johnson, Constance Browne, Mike Hall, John Haggeman, Kim Barrett, Glenda Clayton, Lauren Trute, David and Carolyn Seburn, Sandy Dobbyn, pers. comm. May 25, 2004; Jim Trottier, pers. comm. May 31, 2004; Chris Burns, pers. comm. June 4, 2004; Angie Horner, pers. comm. June 6, 2004; Joël Bonin, pers. comm. June 9, 2004; Ben Porchuk pers. comm. April 1, 2005), as well as in Québec (St-Hilaire 2003; Desrochers and Picard 2005). Additionally, Blanding's Turtles often nest on the gravel shoulders of roads (Standing *et al.* 1999), putting not only nesting females, but also emerging hatchlings at risk.

Furthermore, the rapid development of suitable habitat fragments Blanding's Turtle habitats and populations, isolating them, and preventing any natural rescue effect from

other populations. In the Metropolitan Toronto area, there are still four very small "populations" (Bob Johnson, pers. comm. June 7, 2004). It can be assumed that these populations are now reproductively isolated from one another by commercial and residential developments. The absence of juvenile sightings or reports of nesting females from the Metropolitan Toronto area indicates that suitable nesting sites have most likely been degraded or destroyed and/or there is no successful recruitment. As more suitable habitat is consumed by urban sprawl, one can expect similar fragmentation in other areas in Ontario, as well as in Québec.

In Nova Scotia, the two principal changes in habitat since European colonization have been increased fragmentation of forests and alteration of water flow regimes (primarily for power generation); both have almost certainly had profound effects on turtles (Herman *et al.* 2003). Changes in water flow regimes are a particular concern as they may impede seasonal movements and affect the turtles' ability to nest, feed, and access overwintering sites (Herman *et al.* 2003). Increased human activity associated with roads, cottage development, and agriculture has increased habitat fragmentation and degradation.

Habitat protection/ownership

Blanding's Turtle habitat in Ontario and Québec is protected by many Provincial Parks (P.P.), National Parks (N.P.), and National Wildlife Areas (N.W.A.) including Rondeau P.P., Killarney P.P., Algonquin P.P., Long Point P.P., Gatineau P.P., Point Pelee N.P., Georgian Bay Islands N.P. Big Creek N.W.A., Long Point N.W.A., and Lake St. Clair N.W.A. These areas provide essential habitat protection within park boundaries, although they are not continuous with one another, and as a result may not be sufficient to ultimately offer protection. The ability for these parks to serve as refugia is questionable; the fact that they are not continuous means they do not facilitate the movement of individual turtles from one park to another. In addition, the development of road networks in these parks contributes to increased mortality of Blanding's Turtles (Ashley and Robinson 1996; Gillingwater and Brooks 2001, 2002; Norm Quinn, pers. comm. May 25, 2004). Local populations of Blanding's Turtles within park boundaries may still be declining, as is the case in Kejimkujik N.P. (Jennifer McNeil, Tom Herman pers. comm. Jan. 24, 2005), and in Point Pelee N.P. (Constance Browne, pers. comm. May 25, 2004), or may only be a relict population of an aging cohort (Ben Porchuk April 1, 2005).

In Nova Scotia, one subpopulation is located primarily within Kejimkujik National Park and National Historic Site. The other two subpopulations are in working landscapes. At McGowan Lake, in 2003, a substantial portion of critical habitat (102 ha) was protected by the local forestry company that owned it. An additional 700ha was protected by the provincial government in 2004. Although this action protects much of the McGowan Lake subpopulation, additional areas on private land, including a critical overwintering area, remain unprotected (Tom Herman, pers comm. Jan. 24, 2005). The Pleasant River subpopulation, where land is mostly privately owned and subjected to an array of uses, has been the focus of an intensive community level stewardship campaign in the past two years (Caverhill in progress; as cited by Tom Herman and

Jennifer McNeil, pers. comm. Jan. 24, 2005). (Nova Scotia information supplied by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005.)

BIOLOGY

Although much of the information in this section is from long-term research in Nova Scotia and the United States, the information is pertinent to the Great Lakes/St. Lawrence population. There has been relatively little work done on this species in Ontario and Québec, so one must rely primarily on information from other localities. However, some information was also gathered from biologists and field researchers working in areas where the Blanding's Turtle occurs in Ontario and Québec.

Life cycle and reproduction

Age of juvenile Blanding's Turtles can be estimated from careful counts of growth annuli on plastral scutes (J.D. Congdon, pers. comm. 2004; Congdon *et al.* 1993, 2001). However, age of sexually mature turtles is difficult to determine reliably, and cannot be inferred from body size variation. Females in Michigan with a mean minimum age of 47 years exhibited no significant difference in body size, including straight-line carapace length, when compared to a younger group with a mean age of 21 years (Congdon and van Loben Sels 1991). Sexual maturity has been estimated to occur when a minimum straight-line carapace length of 152mm has been reached (Harding 1997). This minimum straight-line carapace length corresponds with age of maturity of at least 14 years (Congdon *et al.* 2001; Bury and Germano 2002; Herman *et al.* 2003). In the northern areas of the range, including Michigan, Ontario, Québec, and Nova Scotia, maturity is estimated to be delayed up to 25 years of age (Congdon *et al.* 2001; Bury and Germano 2002; Herman *et al.* 2003; Ron Brooks pers. comm.) making it one of the latest maturing species of turtles.

Blanding's Turtles live in excess of 75 years (Congdon *et al.* 1993; Power *et al.* 1994; Congdon *et al.* 2001). At maturity, one clutch of eggs is produced at a frequency of once every 1-3 years (Congdon *et al.* 1983). Clutches range in size from 3-19 eggs (Congdon *et al.* 2001), with an average of 10-15 eggs (Ernst *et al.* 1994). Essentially, the extremely delayed maturity/great longevity life-history strategy of the Blanding's Turtle represents a classic example of a trade-off between adult survival and reproductive output. This trade-off is reflected in the species' highly iteroparous reproduction, low annual reproductive output, and very high annual survival of the adults. As noted elsewhere, populations adopting such a life-history strategy are highly vulnerable to any chronic increase in adult mortality rates, even when these increases are quite small (<5%) (Congdon *et al.* 1993; Samson 2003).

In Nova Scotia, mating has been observed in early spring, mid-summer, and fall (Power 1989; McNeil 2002). Mating activity appears to peak during October and November, after the turtles have aggregated in their overwintering locations (McNeil 2002).

Nesting in Nova Scotia occurs from mid-June to early July, with the majority occurring in the last two weeks of June in most years (Standing *et al.* 1999). In Ontario, the nesting period is slightly earlier, occurring throughout the first three weeks of June, usually peaking around the second week (Lauren Trute, pers. comm. Jan 25, 2005). Nesting activity is concentrated between 1700 and 2300hrs commencing slightly before sundown and finishing after dark (Congdon *et al.* 2000). During the nesting season, females may spend several days terrestrially before nesting activity is commenced (Congdon *et al.* 2000). The nesting period in Ontario, Quebec and Nova Scotia is notably later than in the more southern regions of the Blanding's Turtles range. It is hypothesized that this later nesting period is a direct result of the thermal constraints of individuals living in the northern portion of their range, as temperatures in Nova Scotia, as well as in Ontario/Québec, do not reach the minimum value required for regular activity until later in the season. Hatchlings in Nova Scotia emerge from nests beginning in early September and continue to emerge as late as the last weeks of October (Standing *et al.* 1999; Herman *et al.* 2003). Hatchlings emerge during daylight hours, with 75% emerging before 13:00hrs (Congdon *et al.* 2000).

Female Blanding's Turtles will preferentially choose nesting locations in relatively open areas, such as fields, or disturbed habitats such as roadways (Congdon *et al.* 2000). Nesting in open areas, raises the mean incubation temperature in the nest cavity, which increases the likelihood of a successful nest. Nesting in open areas may, however, lead to an increase in predation rates by mammals (see Predation section).

Rate and success of development of embryos are correlated with the temperature at which the eggs are incubated. The range for successful incubation of eggs is between 22°C and 32°C (Gutzke and Packard 1987). If the temperature falls below or rises above these limits for a significant length of time while the embryos are developing, eggs will fail to hatch or the hatchlings will have reduced viability (Ernst *et al.* 1994).

The size of the clutch is not dependent on the size of the female as described for other species of turtles (Congdon and van Loben Sels 1991, Congdon *et al.* 1993, 2001, 2003). Females over 60 years of age mate and nest more successfully than individuals under 60, particularly compared to mature turtles from the youngest age groups (less than 35 years, Congdon *et al.* 1993). In Nova Scotia, clutch size, as well as age and size at maturity, vary between the populations (Herman *et al.* 2004). The McGowan Lake turtles are smaller, have slower growth rates, mature at a later age and smaller size, and lay smaller clutches than those in Kejimkujik N.P.

Intergeneric hybridization has been observed in rare cases between the Blanding's Turtle and the Wood Turtle (*Glyptemys insculpta*) (Harding and Davis 1999; Bob Knudson, pers comm. May 25, 2004). Harding and Davis noted that the hybridization event during the spring of 1997 resulted in the production of viable offspring. DNA samples were obtained from the hybrid hatchlings, and confirmed maternity and paternity. A similar event was discovered during the summer of 1998, with both events occurring in Michigan. In Ontario, a mating occurrence between a Blanding's Turtle and a Wood Turtle was observed in the Elliot Lake area

(Bob Knudson, pers. comm. May 25, 2004). In the wild, intergeneric hybridization is considered very rare (Harding and Davis 1999).

Predation

Predation on Blanding's Turtle eggs is often extremely high. Congdon *et al.* (1993) reported that within the E.S. George Reserve (Michigan), nest survival ranged from 0% to 63% annually, with a mean survivorship of only 3.3% from 1985 to 1991. The nests of younger Blanding's Turtles are depredated more frequently than those of middle aged or older turtles (Congdon *et al.* 2001). The major mammalian predators of turtle nests in the Great Lakes area are Raccoons (*Procyon lotor*), Striped Skunks (*Mephitis mephitis*), and Red Foxes (*Vulpes vulpes*) (Harding, 1997). Other nest predators include the Coyote (*Canis latrans*), and the Black Bear (*Ursus americanus*) and the Virginia Opossum (*Didelphis virginiana*). Although predation is not the sole cause of poor nest success, it is a limiting factor in many cases (e.g. Browne 2003).

Congdon *et al.* (1993) noted that during their period of study (includes: 1953 to 1957 by O. Sexton, 1968 to 1973 by H. Wilbur, 1975 to 1979 by D. Tinkle and J. Congdon, and 1980 to 1991 by J. Congdon) the period of lowest nest survivorship (mean of 3.3% from 1985 to 1991) coincided with a collapse in the fur market. Trapping intensity on populations of predators was reduced due to public pressure and the decline in economic gain from trapping (Congdon *et al.* 1993). Gillingwater and Brooks (2001, 2002) reported that 55% of observed nests on South Point beach in Rondeau P.P. were depredated in 2000, and 99% of observed nests in 2001. In Nova Scotia, the occurrence of predation by raccoons is high, particularly along lakeshore beaches; these nests are routinely screened for protection. However, inland nests, especially away from areas of high disturbance, appear to experience lower predation in this population (Jennifer McNeil, Tom Herman, pers. comm. Jan 24, 2005).

Hatchling and small juvenile turtles are more susceptible to predation than adults due to their small size, and are eaten by small and large mammals, fish, frogs, snakes, wading birds, and crows (Harding 1997). Predation attempts do not always result in death, but may result in non-fatal amputation of limbs, tail, or claws (St-Hilaire 2003). However, turtles, especially juveniles, with missing limbs do not usually survive more than 1-2 years (Ron Brooks, pers. comm.). There are relatively few predators of adult Blanding's Turtles, as their overall size and strong carapace prevents or deters most predation attempts. Adults could potentially fall prey to large predators such as the Black Bear, or perhaps River Otters (*Lontra canadensis*). During the drought on Pelee Island deceased adult turtles were observed with marks indicating predation, although it is impossible to determine if these injuries were inflicted pre or post mortem (Ben Porchuk pers. comm. April 1, 2005).

The increased predation pressure on hatchling and juvenile Blanding's Turtles results in more cryptic behaviour. Young Blanding's Turtles are more often observed in areas that contain a greater amount of refugia, specifically floating sphagnum mats, than their adult counterparts (Pappas and Brecke 1992).

Physiology

As with several other turtle species, the Blanding's Turtle has a very specific thermal tolerance. Their upper maximum temperature tolerance is 39.5°C, which is one of the lowest critical thermal maxima of any turtle (Hutchinson *et al.* 1966). Minimal thermal tolerance for incubating eggs is 22°C, and the thermal maximum is 32°C (Ewert and Nelson 1991). The thermal tolerance range for incubating eggs in the nest results in high nest failure rates in the northern portion of the species' range; due to fluctuating temperatures, since the eggs have a relatively high minimal thermal tolerance. Sex is determined by temperature sex determination; males are produced when the eggs are incubated at or below 28°C, and females above 30°C (Ewert and Nelson 1991). If the egg volume were to be increased, freezing tolerance in the northern populations would be extended, allowing the eggs to overwinter if required (Bleakney 1963).

Blanding's Turtle eggs are not highly susceptible to drowning, and are able to withstand fairly dry conditions (Packard *et al.* 1982). However, lakeshore nests, which are common in Nova Scotia, are at risk of extended flooding during relatively wet summers. In 2003, all lakeshore nests in Kejimkujik N.P. were lost as a result of late summer flooding (Jennifer McNeil, Tom Herman, pers. comm. Jan 24, 2005). Extensive seasonal flooding of the Ottawa River may lead to nests being submerged for up to 7 days, which would likely prove fatal to the developing embryos.

Interspecific interactions

Parasitism of turtle nests by Sarcophagid fly larvae in Rondeau P.P. was discovered by Gillingwater and Brooks (2001). They reported that in 2000, 39% of all turtle nests on South Point beach were affected by the parasite; the larvae were present in one or more of the eggs and/or hatchlings. In 2001, Gillingwater and Brooks (2002) reported that 100% of Blanding's Turtle nests were attacked by Sarcophagid fly larvae. All infected embryos and hatchlings perished within a few days of infection. This dramatic increase in nest parasitism from 2000 to 2001 is unexplained, but creates concern, as simply employing a standard wire mesh nest protector will not protect the eggs from the Sarcophagid fly. The impact of these flies on freshwater turtles has not been measured or described elsewhere, and at present the importance of this source of mortality is unknown, although it does appear a potentially significant threat.

Blanding's Turtle has a parasitic relationship with two different leech species. Saumure (1990) reported a Blanding's Turtle at Big Clear Lake (Frontenac County, Ontario) with seven leeches, three of which were *Placobdella parasitica*, which is a well known and well documented parasite on many species of turtles. The remainder were *Placobdella ornata*. The leech *P. ornata* had not been previously known to parasitize Blanding's Turtles.

Adaptability

Blanding's Turtles survive in a variety of habitats, which means that a critical habitat is difficult to define. In addition to their natural habitat, Blanding's Turtles may persist in and around major urban centres (Ruben *et al.* 2001; Bob Johnson, pers. comm. June 7, 2004). Unfortunately there is an extremely high nest failure rate (~100%), and an extremely low juvenile recruitment (~0%) into the sexually mature adult population in these urban areas (Congdon and van Loben Sels 1991; Congdon *et al.* 1993, 2001; Ruben *et al.* 2001). The populations that are found in urban centres are physically separated from one another by roadways, as well as urban and commercial developments (Ruben *et al.* 2001). Populations living close to roadways become more susceptible to being struck by vehicles, so it can be hypothesized that populations living in urban landscapes will have higher rates of adult and hatchling mortality. It appears likely that these urban populations are composed of aging cohorts, likely male-biased, with little or no recruitment, and not viable in the long term.

The long generation time of the species (exceeding 40 years) limits its ability to adapt genetically to sudden environmental changes. Populations at the extreme periphery of the species' range are already near the limits of their physiological tolerance, and may be particularly susceptible to climate change and extreme weather events (Herman *et al.* 2003). Small populations of late-maturing individuals are particularly limited in their ability to respond to small increases in adult mortality (<5%), due to the low natural rate of recruitment of juveniles into the sexually mature adult population.

However, their extreme longevity means that individuals will normally be subjected to environmental changes within their lifetime. Although individuals show high fidelity to specific locations, they may be able to shift to new areas when necessary (Herman *et al.* 2003). Shifts in individuals' nesting sites, overwintering sites, and summer home ranges have been documented in the Nova Scotia population, although the cause of these shifts often remains unknown (Power 1989; McNeil *et al.* 2000, unpublished data). Also a shift in adult home range size and habitat selection has been observed during a drought year on Pelee Island (Ben Porchuk, pers. comm. April 1, 2005). In this instance individuals were observed to shift from inland wetlands to coastal Lake Erie areas, and begin to scrape algae from rocks as a food supply.

POPULATION SIZES AND TRENDS

Search effort

There were 1908 sightings reported to the Ontario Herpetofaunal Summary (OHS) database from 1881 to June 6, 2002 (Ontario Herpetofaunal Summary 2004). In Québec, a total of 38 sightings is recorded in NatureServe and the Centre de données sur le patrimoine naturel du Québec (2005), and a total of 100 sightings have been reported to the QAAR (Québec Atlas of Amphibians and Reptiles data bank 2005). In Ontario and Québec, there is very little other published information on the Blanding's

Turtle; however, there is ongoing research being conducted by Bob Johnson (Toronto Zoo) on four very small remnant populations in the Toronto area; by Scott Gillingwater (Upper Thames River Conservation Authority) on populations in Rondeau P.P. and at Big Creek N.W.A.; by Ben Porchuk (Wilds of Pelee Island) on Pelee Island, and in Québec by Daniel St-Hilaire (Société de la faune et des parcs du Québec). Other biologists throughout Ontario and Québec have reported occurrences within their jurisdictions (e.g. Browne 2003).

Most sightings of Blanding's Turtles are of adults, and not juveniles or hatchlings (Ontario Herpetofaunal Summary 2004; NatureServe 2004; Québec Atlas of Amphibians and Reptiles data bank 2005), which is a concern for long-term population stability (Congdon and van Loben Sels 1991; Power *et al.* 1994; Heppell *et al.* 1996; Morrison 1996; Congdon *et al.* 2001; Browne 2003). However, it seems that infrequent observations of hatchlings have been the case as long as people have been studying this species, so it is not clear if this rarity is characteristic of abnormally low recruitment or of a typical stable population.

The only detailed, long-term ecological study of Blanding's Turtle in Canada is being conducted on the Nova Scotia populations. The Kejimkujik N.P. population has been studied since 1969, with intensive work occurring since 1987. In 1996, researchers began looking for Blanding's Turtles outside the park by soliciting the public to report sightings and by systematically trapping and surveying new areas for turtles. The result was the identification of two additional populations: McGowan Lake (intensively studied since 1996) and Pleasant River (intensively studied since 2002). This research has focused on both adult and juvenile distribution, habitat use, and demography; individuals in all age groups have been marked and tracked over time (Tom Herman, Jennifer McNeil, pers. comm. Jan 24, 2005).

In the United States, a long-term study has been conducted at the E.S. George Reserve (part of the University of Michigan) in southeast Michigan, beginning in 1954, and currently being continued by J.D. Congdon (see references). In this report, we have assumed that the Ontario/Québec Blanding's Turtles have life-history traits within the range expressed at the Nova Scotia and Michigan study sites. In general, the more northern turtles of Nova Scotia have later maturity and lower annual reproductive output than turtles in southeast Michigan. These differences are probably a consequence of shorter and cooler active seasons in populations existing at higher latitudes.

Abundance

It is difficult to estimate the abundance of Blanding's Turtles in Ontario/Québec, as there has been very little work on abundance or population trends in this region. In the OHS database, there were 1248 sightings of Blanding's Turtles from 1984 to 1994, and from 1995 to 2002 there were 163 Blanding's Turtle sightings reported. This accounts for 10.3% and 8.9% of all Turtle sightings reported during those time periods respectively (Michael J. Oldham, pers. comm. Oct. 13, 2004). It is probable that the decrease in the number of sightings does not correspond to a reduction in the

population, but is simply a reduction in the total number of turtle sightings being reported. In Quebec, the Blanding's Turtle is quite rare, and the populations are isolated. It has been reported that in the Gatineau Park, densities may be as low as less than one per km^2 (McMurray 1984).

An overall estimate of the number of adult Blanding's Turtles in the Great Lakes/St. Lawrence population necessarily must be crude. It doesn't appear that any population exceeds 1000 mature individuals, and although some exceed 100 adults and the Big Creek N.W.A. may have 600 adults, most populations are much smaller. The great majority of reports of Blanding's Turtles to the O.H.S. are of fewer than 5 individuals. There are approximately 150 Element Occurrences (EO) in Ontario (Austen and Oldham 2001) and many of these sites are small and have few adults observed (Austen and Oldham 2001). To achieve a total population estimate of 10,000 adults for the Great Lakes/St. Lawrence population requires an average of 65 adults per EO. This average seems high given the observations in the O.H.S. database. Therefore, a maximum Great Lakes/St. Lawrence population estimate of 10,000 adults is not unreasonable. This seems like a substantial number, but given the life history of the species, as described elsewhere throughout this report, these numbers may represent primarily older cohorts that are declining from increased mortality and very low recruitment.

In a study in 2001-2002, Browne (2003) captured and marked 95 Blanding's Turtles in Point Pelee National Park. She concluded that a larger mean body size in her turtles compared to the mean size in an earlier study (Rivard and Smith 1973 cited in Browne 2003) meant that the mean age of the population was older in 2003. However, the long-term study at ESGR in Michigan found no support for the notion that adult body size in this species correlates with age (Congdon and Van Loben Sels 1991; Congdon *et al.* 1993, 2001). Browne (2003) also concluded that observed rates of mortality of adult Blanding's Turtles on the roads in and around Point Pelee N.P. could cause population declines. She reported nest predation at 70%, and concluded that this rate of loss would also lead to declines in the Blanding's Turtle populations (Browne 2003). Using a model (Ramas simulation) and admittedly limited data, Browne found that if one extra (beyond natural mortality) adult female is killed by a vehicle every two years, and if nest mortality is >32% annually, the population would slowly decline to extinction (Browne 2003, p. 72-74).

In Big Creek N.W.A., 429 adult Blanding's turtles have been individually marked (Scott Gillingwater, unpublished data). This population is by far the largest documented in Canada, and most others are likely much smaller. The Big Creek population has been noted by Saumure (1997) to be male-dominated. A Z-score comparing the observed ratio of males (55.5%) (Gillingwater unpublished data) to the expected sex ratio of 1:1, indicates that this population is significantly male-dominated ($p<0.05$). A finite population correction factor was calculated using the upper confidence interval (N=1326) for the population size estimated by Saumure (1997) and gave a significant bias from the expected 1:1 male to female ratio ($p<0.05$). A significant difference from the expected 1:1 sex ratio is present even if the finite population correction factor is

calculated with a total population size of 5000 ($p<0.05$) (Chris Edge pers. comm.) A male-biased population could be the result of road mortality affecting nesting females more than their male counterparts, as this species often nests on the gravel shoulders of roadways (Saumure 1995, 1997; Standing *et al.* 1999). Females likely suffer higher road mortality than do males at Big Creek N.W.A., which has a major highway through the wetland where many turtles are killed each year (Ashley and Robinson 1996).

Recent studies on Snapping Turtles (*Chelydra serpentina*) in the USA have concluded that this species and Painted Turtles (*Chrysemys picta*) develop male-biased sex ratios and skewed age (adult biased) distributions toward adults (Marchand and Litvaitis 2004; Gibbs and Shriver 2002; Steen and Gibbs 2004; Tucker and Lamer 2004). In one paper, collecting of females nesting on the roadside plus female-biased mortality were cited as the cause of male-biased sex ratios (80-85% male) (Tucker and Lamer 2004). This latter study was conducted on Snapping Turtles that were being taken for food or eggs, but these results would apply to Blanding's turtles being collected for the pet trade and being killed by vehicles.

In Nova Scotia, approximately 250 individual adult Blanding's Turtles have been encountered since 1969 (Herman *et al.* 2003). Initial population size estimates calculated for turtles in the Kejimkujik subpopulation, using data from 1969 to 1988, resulted in an estimate of 132 adults (Herman *et al.* 1995). However, these estimates were based on limited capture-mark-recapture data. Recently, Jolly-Seber estimates based on more extensive and more long-term data indicate that the number of adults in Kejimkujik N.P. is only about 66 (Tom Herman, pers. comm. E-mails April 28, 30, 2005). The subpopulation at McGowan Lake is estimated to contain 79 adults (95% CI: 59.9-116.5), based on capture-mark-recapture data from 1996 to 2001 (McNeil 2002). No population estimates have been calculated yet for the Pleasant River sub-population; however, this sub-population is believed to be the largest in the province. Sixty-five adults have been marked in this population; 57 of these have been marked in three years of intensive sampling (Caverhill 2003; Caverhill in progress; as cited by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005). In the most recent estimates, the total population of adults in Nova Scotia is: Kejimkujik N.P.= 66; McGowan Lake=79; and Pleasant River=65-100 =210-245. (Tom Herman, pers. comm. April 28, 2005) (Nova Scotia information supplied by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005).

Fluctuations and trends

Congdon *et al.* (1993) used Euler's equation to predict the survivorship of juveniles and hatchlings necessary to sustain a population at the University of Michigan's E.S. George Reserve (ESGR). The calculations were based on data collected on Blanding's Turtle populations from 1975 to 1986, and also in 1991. These data indicate that from 1976-1984 the mean annual nest survivorship was 43.8%, with the value falling to 3.3% during 1985 and 1991, giving an overall mean of 26% annually. From the same data, mean annual adult survivorship was reported at 96%. According to Euler's equation, a stable population requires the annual juvenile survivorship to be in excess of

72%. This calculation is set with an age of maturity of 14 years, the lowest speculated for the Blanding's Turtle at ESGR.

The age of maturity for Blanding's Turtles in Ontario/Québec should be considered to be closer to 20 years, and possibly exceeding 25 years for the northern portion of the species' range (Ron Brooks, pers. comm.). In the northern portion of the species' range, turtles experience shorter active seasons and cooler temperatures, which is indicative of a later age of maturity. If the age of maturity increases to 20 years (from 14 years), the necessary annual juvenile survivorship, predicted by Congdon *et al.* (1993), is increased to 85%. If age at maturity increases to 25 years, as appears possible in Nova Scotia and likely for Ontario/Québec, then the annual juvenile survivorship needs to approach 90% to maintain the population at a stable level.

Average annual nest survivorship in Ontario could be as low as 5% for areas such as Rondeau P.P. (Scott Gillingwater, pers. comm. Feb 16, 2005). The average annual nest survivorship for the Great Lakes/St. Lawrence population is most likely in the range of <1% for metropolitan areas to 15% for a pristine environment, with an overall average of 3-4% (Congdon *et al.* 1993, Herman *et al.* 2003). The Euler's equation predicts that a drop in annual nest survivorship to 5% corresponds with a necessary increase in annual juvenile survivorship of 10%, for the population to remain stable.

More closely representing the Great Lakes / St. Lawrence population would be a reduction in nest survivorship to 15% for a pristine environment. Congdon *et al.* (2000) investigated the percentage of eggs to produce viable hatchlings; this value was estimated at 17.6% for the population on the ESGR in Michigan. This could be balanced by increasing adult survivorship by 1.5%, to 97.5%, which would then increase the generation time to 40 years. Adult survivorship is the most difficult to increase of all the life stages, so this does not appear to be a viable option to stabilize the population. Embryo survivorship to hatching of 17.6% may be an overestimate for the northern portion of the Blanding's Turtles range. Eggs in the northern portion of the species range are more susceptible to environmental changes, due to a decrease in the length of the active season as a result of cooler temperatures.

A long-term study of Painted Turtles in Algonquin Park, Ontario, has estimated annual survivorship of adults at 98-99%, and of juveniles greater than 5 years of age at 90-95% (Samson 2003). The Blanding's Turtle is not nearly as common or widespread as the Painted Turtle. The reasons for these differences are not known, but it is possible that the extreme delay in age at maturity in Blanding's Turtles (Painted Turtles mature at 5-14 years in Ontario, maturing earlier as one goes south) is a significant reason for its lower abundance. Blanding's Turtles also reproduce less often (less than one clutch per year) than the Painted Turtle (1-2 clutches per year).

In Nova Scotia, a recent population viability analysis identified an alarming decline in the Kejimkujik N.P. subpopulation (Herman *et al.* 2004). A deterministic stage based matrix was constructed using the following average annual survivorships calculated from life-history data collected from the population: adult 94% (confidence interval

85%-100%), large juvenile (10-18.49cm) 89%, small juvenile (5-9.99cm carapace length) 69%, hatchling 12%, and egg 60% (based on the current program of screening nests against predators). Despite the apparently high adult and juvenile survivorships, the model indicated that without intervention, the Kejimkujik N.P. population would continue to decline. Although the model is most susceptible to changes in adult mortality, it is difficult to increase survivorship in this life stage. Modeling the effect of different management regimes (one year headstarting, two year headstarting, laboratory incubation of eggs) indicated that enhancing the survival of early life-stages also has the capacity to stabilize the Kejimkujik N.P. population (Herman *et al.* 2004) (Nova Scotia information supplied by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005).

In the Greater Chicago Metropolitan Area (GCMA), Ruben *et al.* (2001) examined populations that had been separated by urban sprawl for evidence of genetic differentiation or loss. They compared the differentiation in the GCMA population to other populations that were not physically separated, such as the ESGR and Kejimkujik N.P. populations. Results indicated no genetic differentiation among Chicago populations, but significant loss of variability compared to the population on the ESGR, which is considered to be panmictic, and with the Kejimkujik N.P. population, which is not panmictic (Mockford *et al.* 2005).

Rescue effect

In Ontario, there is little potential for rescue effect except perhaps along the upper St. Lawrence River, in the Thousand Islands area. However, there is no evidence that turtles are crossing over in this region and indeed it appears that extreme eastern Ontario is one of the areas from which Blanding's Turtles have been extirpated, or were never present (Figs.2, 3; Ontario Herpetofaunal Summary 2004; Michael Oldham, pers. comm. Oct. 13, 2004). A similar situation exists in southwest Ontario along the St. Clair and Detroit Rivers; a rescue effect might be possible, but again there is no evidence that the Blanding's Turtle lives on the Ontario side of the St. Clair River. Blanding's Turtles do occur on the Canadian shorelines of Lake St. Clair and the Detroit River, so it is possible that turtles could enter Canada in these regions. However, it seems more likely that any successful migration would be in the opposite direction. Essentially, there seems to be no potential for rescue effect and certainly no evidence offering support. Along the Ottawa River, exchange of individuals between Ontario and Québec populations could possibly be limited due to the increase in the breadth of the Ottawa River due to significant damning for hydro electricity. Populations do however exist on both sides of the Ottawa River, and in order to support this hypothesis of a significant barrier, more information is needed.

Genetic evidence from the NS population indicates significant spatial structure among the three known subpopulations, with no evidence of recent bottlenecks. Estimates of gene flow are very low (1.8 – 5.8 individuals per generation), despite proximity (15-25 km) of the three subpopulation centers (Mockford *et al.* 2005) (Nova Scotia information supplied by Tom Herman and Jennifer McNeil, pers. comm. Jan. 24, 2005).

LIMITING FACTORS AND THREATS

Because individual Blanding's Turtles travel large distances over land, they are particularly susceptible to being struck and killed crossing roadways (Ashley and Robinson 1996; Harding 1997), especially because this species tends to travel along roadways (Ron Brooks, pers. comm.). Instances of dead on road Blanding's Turtles have been reported in Scarborough, Point Pelee N.P., Algonquin P.P., Sudbury, St. Clair N.W.A., Halton, Long Point P.P., Parry Sound, Renfrew, Merrickville, Rondeau P.P., Kempville, and Bancroft (Ashley and Robinson 1996; Bob Johnson, Constance Browne, Norm Quinn, Mike Hall, John Haggeman, Kim Barrett, Glenda Clayton, Lauren Trute, David and Carolyn Seburn, Sandy Dobbyn, pers. comm. May 25, 2004; Chris Burns, pers. comm. June 4, 2004; Angie Horner, pers. comm. June 6, 2004; Ontario Herpetofaunal Summary 2004). Blanding's Turtles have also been reported dead on roadway in Québec (Desroches and Picard 2005), in the regions of Outaouais, and west of Gatineau Park (Jean-François Desroches, pers. comm. May 25, 2004; Daniel St-Hilaire, pers. comm. June 1, 2004; Joël Bonin, pers. comm. June 9, 2004). Of the 1908 records for Blanding's Turtles in the OHS database, 9.8% were reported dead on roadway (DOR) (Oldham 1998). Again, given the long-lived life history of this species, losses of adult females to vehicles have a long-term impact on the population, and it is difficult for the population to recover from these losses (Congdon *et al.* 1993, Herman *et al.* 2003). This concern has been realized in the male-biased population in Big Creek N.W.A. (Saumure 1995, 1997; Gillingwater unpublished data).

The development of wetlands and the terrestrial ecosystems that surround them is a severe threat to the population of Blanding's Turtles in Ontario/Québec. Not only must the waterways and the immediate surrounding areas be protected, but also nesting areas as far as 1620m from such waterways (Joyal *et al.* 2001).

The development of interest from the pet trade for Blanding's Turtles presents a threat to survivorships of all ages. Captive-bred yearling Blanding's Turtles are for sale online by the Amazon Reptile Center (2005). These animals are also available to Canadian residents (Amazon Reptile Center, pers. comm. Feb. 16, 2005). This relatively high price makes it very appealing for individuals to risk fines and imprisonment, for the potential financial windfall that the sale of a few individuals can bring. Individuals who collect species from the wild do not discriminate between age classes, and will remove whatever they can catch. Usually, adult females are removed from wild populations as they are easier to locate and catch, and will receive a higher price at sale, and may provide a clutch of eggs as well. Removal of individuals from the wild for the pet trade is a developing threat, but the severity of its impact is difficult to estimate at this time. However, a recent study on impact of collection of roadside nesting female snapping turtles suggests the impact can be very significant (Tucker and Lamer 2004).

SPECIAL SIGNIFICANCE OF THE SPECIES

Blanding's Turtle is of biological significance because it is one of the longest lived freshwater turtles, with a lifespan exceeding 75 years (Congdon *et al.* 1993; Congdon *et al.* 2001; Ruben *et al.* 2001). Thus, the Blanding's Turtle has been used in models of conservation and demography (Congdon *et al.* 1993), and to test competing hypotheses on why and how organisms age (Congdon *et al.* 2001, 2003). It is also the only living representative of the genus *Emydoidea*. Blanding's Turtles have one of the smallest global ranges of Canadian reptiles, and a large portion of that global range (approximately 20%) is found in south-central Ontario and in Québec (Austen and Oldham 2001). This turtle is also considered at risk in the majority of its global range (NatureServe 2004). As such, the Blanding's Turtle has been widely adopted as a "poster" species to publicize and educate on various issues including species at risk, conservation, wildlife protection, and conservation research. For example, the Nova Scotia Liquor Commission raised funds for conservation, with a Blanding's Turtle t-shirt. A Turtle Watch poster campaign, also in Nova Scotia, raised public awareness of turtles at risk, and this poster was later adapted for use in Québec. Similarly, Michigan, Wisconsin, and Minnesota have used Blanding's Turtles in education programs and road-crossing signs.

Blanding's Turtles exhibit all the characteristics of a long-lived species, and it provides an excellent opportunity to study and create conservation strategies that are more effective at protecting long-lived species.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Blanding's Turtle population in Nova Scotia received status under COSEWIC in 1993 when it was designated as Threatened. At that time, the majority of known turtles occurred within Kejimkujik N.P., where its habitat and populations are protected federally. Since then, it has become clear that the majority of turtles occur in working landscapes outside the national park. In 2001, Nova Scotia designated the population as Endangered (Sherman Boates, Tom Herman, pers. comm. Jan. 24, 2005). In Ontario, Blanding's Turtle was designated as Threatened by the Ontario Ministry of Natural Resources in 2004 (Ontario Ministry of Natural Resources 2004) under the recommendation of COSSARO in 2001 (Austen and Oldham 2001). In Québec, the Provincial Advisory Committee recommended that the Blanding's Turtle be designated as Threatened in 2003. It has also been ranked by NatureServe as S1 in Québec. In the United States, the Blanding's Turtle is listed at some level of peril in 14 of 15 states where it is found (Table 1).

Table 1. NatureServe rank for the Blanding's Turtle (*Emydoidea blandingii*) for all jurisdictions within its global range.***

State\Province	S1: Critically Imperiled	S2: Imperiled	S3: Vulnerable	S4: Apparently Secure
Pennsylvania*	X			
Missouri	X			
South Dakota	X			
Québec	X			
Nova Scotia**	X			
Minnesota*		X		
Maine		X		
Massachusetts		X		
Ohio		X		
Indiana		X		
New York*		X		
Ontario		X		
Wisconsin			X	
Iowa*			X	
Illinois			X	
Michigan			X	
New Hampshire			X	
Nebraska				X

*= Noted as declining in these jurisdictions.
**= Noted as declining. Rank taken from Nova Scotia SAR website www.gov.ns.ca/natr/wildlife/endngrd/specieslist)
***= Blanding's Turtle is Extirpated from Rhode Island

The IUCN status is LR (Lower Risk) and the Global Status is G4. In Canada and the U.S., the National Status is N4.

TECHNICAL SUMMARY

Emydoidea blandingii (Nova Scotia population)
Blanding's Turtle — Tortue mouchetée
Range of Occurrence in Canada: Southwestern Nova Scotia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)*	~900 km²
• *Specify trend in EO*	Declining
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)*	<100 km²
• *Specify trend in AO*	Declining
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	3 populations; Kejimkujik National Park, McGowan Lake and Pleasant River.
• *Specify trend in #*	Stable
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Currently, stable or increasing from restoration efforts.
Population Information	
• *Generation time (average age of parents in the population)*	>40 years
• *Number of mature individuals*	210 – 245
• *Total population trend:*	Likely declining
• *% decline over the last/next 10 years or 3 generations (> 120 years).*	% is unknown, but likely significant
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes, there is little or no exchange between the 3 populations.
• *Specify trend in number of populations*	Stable
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each:	Kejimkujik, 66; McGowan Lake, 79; Pleasant River, 65-100; total = 210 – 245

Threats (actual or imminent threats to populations or habitats)	
- Small population size and fragmentation, which increases threats from genetic drift and environmental stochasticity. - Vulnerability to small increases in adult mortality because of long-lived life history. - Loss of wetland habitat and surrounding terrestrial habitats. - Lack of good nest sites and the attractiveness of road shoulders and surfaces to nesting females. - Expansion of agriculture, forestry and cottage development, which fragment the populations. - Nest predation and predation of juveniles by skunks, raccoons, and foxes is likely higher than historic rates because of subsidization of raccoons, skunks, decline of the fur market, and increase in edge habitat. - Collection for the pet trade. - Alteration of hydrology by human activity.	
Rescue Effect (immigration from an outside source)	Unlikely
• *Status of outside population(s)?* **USA: Critically Imperiled – South Dakota, Pennsylvania, and Missouri** **Imperiled – Minnesota, New York, Massachusetts, Maine, Indiana, and Ohio** **Vulnerable – Michigan, New Hampshire, Iowa, Illinois, and Wisconsin**	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	Unknown
• *Is there sufficient habitat for immigrants in Canada?*	Not applicable
• *Is rescue from outside populations likely?*	No
Current Status COSEWIC: Endangered (May 2005) Nova Scotia Wildlife Protection: Endangered	

Status and Reasons for Designation

Nova Scotia Population

Status: Endangered	**Alpha-numeric code**: B1ab(iii,v)+2ab(iii,v); C2a(i); D1
Reasons for Designation The three small subpopulations of this species found in central southwest Nova Scotia total fewer than 250 mature individuals. These three subpopulations are genetically distinct from each other and from other Blanding's turtles in Quebec, Ontario and the United States. Although the largest subpopulation occurs in a protected area, its numbers are still declining. The other subpopulations are also susceptible to increasing habitat degradation, mortality of adults and depredation on eggs and hatchlings.	
Applicability of Criteria **Criterion A** (Declining Total Population): Not calculated. **Criterion B** (Small Distribution, and Decline or Fluctuation): Endangered, B1(EO <900km2)+2(AO < 100km2)a (<5 locations) b(iii, v). **Criterion C** (Small Total Population Size and Decline): Endangered, C (<2,500 mature individuals), 2 (fragmented), i (no population > 250). **Criterion D** (Very Small Population or Restricted Distribution): Endangered D1 (<250 mature individuals). **Criterion E** (Quantitative Analysis): Not applicable.	

TECHNICAL SUMMARY

Emydoidea blandingii (Great Lakes/St. Lawrence Population)
Blanding's Turtle — Tortue mouchetée
Range of Occurrence in Canada: Southern and central Ontario and southwestern Québec

Extent and Area Information	
• *Extent of occurrence (EO)(km²)*	~73,800 km²
• *Specify trend in EO*	Declining
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)*	< 835 km²
• *Specify trend in AO*	Declining
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	Many locations. Northern portion of range may consist of many small isolated populations
• *Specify trend in #*	Declining
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Decline in quality and extent of habitat with increased fragmentation from roads, development and wetland drainage
Population Information	
• *Generation time (average age of parents in the population)*	>40 years
• *Number of mature individuals*	<10,000
• *Total population trend:*	Declining
• *% decline over the last/next 10 years or 3 generations (>120 years)*	Unknown, but likely substantial because 3 generations would be since ~1885
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes, in some parts of their range in the north and around areas with extensive wetland drainage and/or development
• *Specify trend in number of populations*	Declining
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each	Unknown
Threats (actual or imminent threats to populations or habitats)	
- Vulnerability to small increases in adult mortality because of long-lived life history - Loss of wetland habitat and surrounding terrestrial habitats - Loss of nesting habitat and the attractiveness of road shoulders and surfaces to nesting females - Expansion of development/roads, which fragments populations - Nest predation and predation of juveniles by skunks, raccoons, and foxes is likely higher than historic rates because of human subsidization of raccoons, skunks, decline of the fur market, and increase in edge habitat - Depredation of eggs and hatchlings by sarcophagid flies is a potential new threat - Collection for the pet trade - There is some evidence that nests on roadsides have a higher rate of depredation - Increased rates of mortality, particularly of nesting females by vehicles, and the expanding road network and concomitant increased traffic density and speed throughout the Ontario/Quebec range	

Rescue Effect (immigration from an outside source)	Unlikely
• *Status of outside population(s)?* **USA: Critically Imperiled – South Dakota, Pennsylvania, and Missouri** **Imperiled – Minnesota, New York, Massachusetts, Maine, Indiana, and Ohio** **Vulnerable – Michigan, New Hampshire, Iowa, Illinois, and Wisconsin**	
• *Is immigration known or possible?*	Not likely possible and there is no evidence that it does occur
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	No
Current Status COSEWIC: Threatened (May 2005) COSSARO (Ontario): Threatened	

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code:** C2a(i)
Reasons for Designation The Great Lakes/St. Lawrence population of this species although widespread and fairly numerous is declining. Subpopulations are increasingly fragmented by the extensive road network that criss-crosses all of this turtle's habitat. Having delayed age at maturity, low reproductive output and extreme longevity make this turtle highly vulnerable to increased rates of mortality of adults. Nesting females are especially susceptible to roadkill because they often attempt to nest on gravel roads or on shoulders of paved roads. Loss of mature females in such a long-lived species greatly reduces recruitment and long-term viability of subpopulations. Another threat is degradation of habitat from development and alteration of wetlands. The pet trade is another serious ongoing threat because nesting females are most vulnerable to collection.	
Applicability of Criteria **Criterion A** (Declining Total Population): Not appropriate **Criterion B** (Small Distribution, and Decline or Fluctuation): Not appropriate, possibly not severely fragmented yet and >10 locations **Criterion C** (Small Total Population Size and Decline): Threatened, C, fewer than 10,000 mature individuals, 2 (continuing decline projected), ai (no population with >1000 mature individuals) **Criterion D** (Very Small Population or Restricted Distribution): Not appropriate **Criterion E** (Quantitative Analysis): Not applicable	

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Chris Edge is currently enrolled as an undergraduate at the University of Guelph in the BSc(H) Zoology program. He has always had an interest in reptiles and amphibians since an early age. His enrolment at the University of Guelph has focused his early interest in amphibians and reptiles towards their conservation and protection. His specific interests lie within the life history adaptations that have allowed different species to survive at higher latitudes, as well as the behavioral and physiological adaptations that allow species to adapt to a cooler and shorter active season. His

fascination with ecological procedures and applications will prove useful as he pursues future endeavours in reptile and amphibian ecology. The education of the public in the conservation concerns facing Ontario's native herpetofauna is one of his goals, and this has been achieved through participation in herpetology outreach programs in elementary and secondary schools.

Steve Jones

Steve Jones is a BSc(H) Biology graduate from the University of Guelph. During his undergraduate degree, Steve assisted in an ecotoxicology lab, studying the effects of contaminants on the development of the Snapping Turtle (*Chelydra serpentina*). Steve was a volunteer teaching assistant in the Herpetology class laboratory, and often assisted with the care and keep of the Herpetology Teaching Specimens. He is currently enrolled in the Faculty of Education at the University of Ontario (UOIT). His future endeavours and interests include continuing studies in conservation biology and investigating the spatial ecology of reptiles in the northern periphery of their range. His main goal is to educate the general public on the biology of local herpetofauna in a hope to increase support for their conservation. For the past few years, Steve has participated in, and developed, herpetology outreach programs for elementary and secondary schools. These programs give the opportunity for younger students to learn about these often mysterious animals, have a chance to interact with them, and learn about the conservation concerns that face all reptiles in Ontario.